Comparing the Effects of Discretionary Tax Changes Between the US and the UK*

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Abstract

The remarkable similarities of the effects of discretionary tax changes between the US and the UK, shown in Cloyne (2013), raise the obvious concern whether the effects of tax changes at disaggregated levels in the UK still resemble those in the US. This paper investigates the issue along three dimensions – corporate and personal income tax changes, anticipated and unanticipated tax changes, and positive and negative tax changes. An important contribution of this paper is to construct a data set on exogenous changes of corporate and personal income taxes in the UK, identified from narrative sources along the lines of Cloyne (2013).

JEL Classification: E23, E62, H2, H3.
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1 Introduction

With narrative account measurement of tax changes, Romer and Romer (2010) find a large and persistent effect of tax changes in the US. Following a cut in tax liabilities corresponding to 1 percent of GDP, output rises by 3 percent two and a half years after the shock. Cloyne (2013) documents discretionary tax changes in the UK and shows the impact of tax changes on output resembles those in the US. The remarkable similarities of tax effects between the US and the UK raise the obvious concern whether the effects of tax changes at disaggregated levels in the UK also resemble those in the US. In this paper, we investigate the issue along three dimensions – corporate and personal income tax changes, anticipated and unanticipated tax changes, and positive and negative tax changes. We document interesting differences in the way key macroeconomic variables react to different types of tax changes across the two countries.

Our empirical analysis follows the narrative approach, that is, estimating the tax effects by constructing explicitly a series of exogenous tax changes. An important contribution of this paper is to construct a data set on exogenous changes of corporate and personal income taxes in the UK. We start with Cloyne (2013) data series. Often, we have to go back to the original sources, including the House of Common Debates, Budget and Pre-Budget reports etc., to look for the information of the relevant tax changes. Our classification of taxes into changes in corporate or personal income taxes for the UK is based on the motivation behind each tax change. Changes in corporate income taxes include those measures that were designed to affect the industry and businesses. Changes in personal income taxes include those measure that were designed to affect individual income. This motivation driven classification of tax changes is very similar and comparable to the classification of Mertens and Ravn (2013) of corporate and personal income taxes in the US. Moreover, we distinguish between anticipated and unanticipated tax changes on the basis of the time difference between the announcement and implementation dates of tax changes, provided by Cloyne (2012). For the series of various tax changes in the US, we use those provided by Mertens and Ravn (2012) and Mertens and Ravn (2013).

Our analysis reveals important differences in the responses of macroeconomic variables to various types of tax changes across the US and the UK. The key differences for output responses are:

- For changes in both corporate and personal income taxes, the effects in the UK are relatively smaller than those in the US. For corporate income tax changes the responses of the UK economy are more sluggish, while for personal income tax changes, the responses of the US economy are more sluggish;

- Output falls slightly when a tax cut is announced in the US, whereas it increases substantially when it is announced in the UK;

- For a positive tax change (tax increase), output in the UK falls sharply, while output responses in the US are insignificant. For a negative tax change (tax cut), output in the US increases , while output responses in the UK are insignificant. Nevertheless, these results are sensitive to the outliers. After removing the outliers, for a tax increase responses in both countries are insignificant, and for a tax cut responses in both countries are similar to each other.

Furthermore, we document a number of other interesting results for responses of consumption and investment as well. We find that for the effects of various types of tax changes, consumption responds almost one-for-one with respect to output responses in both countries. However, investment responses with respect to output responses in the UK are generally smaller than those in the US.

This paper relates to a large strand of literature in investigating macroeconomic effects of tax changes, which often differ in how to address endogeneity issue. One approach is to adopt structural vector autoregressions (VAR) and identify exogenous tax changes by imposing certain constraints (e.g. Blanchard and Perotti, 2002). Our paper is in line with the recent development of using narrative approach to identify exogenous tax changes in the US, pioneered by Romer and Romer (2010) and followed by many other studies. Most notably, Mertens and Ravn (2013) divide the Romer&Romer tax series into changes in personal and corporate income taxes, which are then used as proxies in a structural VAR framework. They find that changes in personal income taxes have large and persistent effects on output whereas corporate income tax changes have smaller effects on output in the US. Hussain (2015) also uses these tax series to study the effects of corporate and personal income taxes on total factor productivity of the US. Moreover, Mertens and Ravn (2012) construct anticipated and unanticipated tax changes for the US, and find significant anticipation effects – output fall when a tax cut is announced. In addition, Hussain and Malik (2016) investigate the asymmetric responses of positive and negative tax changes in the US.

The studies mentioned above are all conducted for the US economy only.[1] The reason is that no such exogenous series of tax changes was constructed for other countries, until Cloyne (2013) constructed a similar series for the UK. It closely follows Romer and Romer (2010) by painstakingly categorizing each of tax changes for the UK, and generates comparable exogenous tax series to those in Romer and Romer (2010). This provides economists a rare opportunity to compare and contrast the effects of tax changes between the two countries, given most of studies focus on only one country. Jones et al. (2015) is the first paper using these narrative tax measures and examining asymmetric tax effects for the US and

[1]There is also an interesting, but rather different strand of literature looking at the effects of fiscal consolidation plans at 17 OECD countries. Alesina et al. (2015) use narratively identified fiscal adjustments to build exogenous plans, which are unlikely to be systematically correlated with other developments affecting output. The key point of the paper is to study fiscal plans a composition of fiscal adjustment, rather than individual shifts in fiscal variables as it is normally done in the literature.

the UK. However, they only look at the differential effects of positive and negative tax changes and their empirical methods are also problematic.[2] Our paper provides a much more comprehensive comparison of tax effects between the US and the UK incorporating three dimensions – corporate and personal income tax changes, anticipated and unanticipated tax changes, and positive and negative tax changes. Nguyen et al. (2017) decompose the Cloyne (2012) tax series into changes in consumption tax and income tax, and estimate the effects of exogenous changes in income and consumption taxes.

Our paper shows that various types of tax changes between the two countries can have different quantitative and qualitative impacts, in spite of the similarities for the total tax changes. For instance, the effects of both corporate and personal income tax changes in the UK are relatively smaller than those in the US. For corporate income tax changes the responses in the UK are more sluggish, while for personal income tax changes the responses in the US are more sluggish. These results suggest that it is important to take into account such differences before designing a taxation policy for a specific country since generalizing the effects of tax changes across countries may lead to sub-optimal results. Our results also highlight the importance of studying country specific attributes of tax changes. For example, in the UK, those personal income tax changes which are offset by consumption taxes at the same time are endogenous and potentially contaminate the estimated effects of personal income tax changes. Similarly, in the UK, the effects of positive and negative tax changes are similar to those in the US, once we remove the 1979 and 1988 outliers, which are considered to be endogenous as they are implemented after two general elections (Nguyen et al., 2017). Therefore, it is important to study whether the impacts of changes in certain taxes are because of an underlying structural feature of the economy or whether they are simply driven by attributes of the tax policy. The mechanisms responsible for the differential tax effects across countries require further detailed examinations, which are beyond the scope of this paper.

The paper is organized as follows: section 2 and 3 describe data and empirical methodology. Section 4 present the results for the impact of tax changes at various disaggregated levels. Sector 5 concludes.

2 Data

With narrative records of legislated tax changes, Romer and Romer (2010) and Cloyne (2013) classify those that are not in response to contemporaneous changes in the economy as

[2]For example, the computation of impulse responses in their paper does not take into account the lagged effect of the dependent variable (the reported impulse responses are just the sum of the coefficients on the current and lagged values of tax series). Also, as shown in Kilian and Vigfusson (2011), linear impulse responses can be misleading in a non-linear model.

exogenous tax changes, for example, tax changes made to fund war time expenses or those made to stimulate long-run growth. For the periods examined in each of the papers, there are in total 45 quarters with exogenous tax changes in the US, and 124 quarters with exogenous tax changes in the UK. Mertens and Ravn (2012) and Mertens and Ravn (2013) look further into the exogenous tax series in the US, providing us with anticipated and unanticipated, and corporate and personal income tax series for the US. An important contribution of this paper is to construct a data set on exogenous changes of corporate and personal income taxes in the UK, using narrative sources along the lines of Cloyne (2013).

2.1 Corporate and Personal Income Tax Changes in the UK

We start with the exogenous tax series of Cloyne (2012). For each of exogenous tax changes documented in Cloyne (2012), we try to classify it as one of the following categories: corporate income tax change, personal income tax change, or other tax change. However, there are three issues. First is that some tax changes can not fall easily into any of the categories. For these, we have to refer back to the original sources – House of Common Debates, Budget and Pre-Budget reports etc., and find out what the tax changes are intended for, and which part of tax changes can be clearly classified into these categories. Secondly, it is not clear how to treat employment taxes in that whether they should be part of the personal income tax series or corporate income tax series. We construct two different tax series: the baseline is the one without employment taxes in the personal income tax series and the alternative tax series is the one with employment taxes included in the personal income tax series. Thirdly, the tax series in Cloyne (2012) incorporate the consumption tax changes, implemented to offset the effects of changes in personal income tax on government budget.[3] To construct the baseline personal income tax series, we exclude those tax changes which are offset by consumption changes, as those tax changes could be endogenous. For more detailed accounts on the classification of corporate and personal income tax changes, please refer to the data appendix.[4] Here, we provide two examples to illustrate how we classify the corporate and personal income tax changes.

One example is the tax changes proposed in the extra measures in 1970. There were significant changes in both of the categories. In corporate income taxes, there was abolition of the investment grants scheme (recorded as expenditure) and the introduction of a new system of capital allowances. These capital allowances were implemented on 27th October 1970 for the purpose of long run growth and were assigned a figure of 470 million in a full year (Cloyne, 2012). Moreover, the standard rate of income tax was announced to be cut from April 1971. Although not much information regarding the motivation behind the tax

[3]These included changes in VAT, excise, and duty taxes

[4]The data set that we construct is only for those changes that we identified as exogenous by Cloyne (2013).

cut was given, it was classified as an ideological change based on the theme of the budget, that is, providing incentives and allowing citizens to keep more of their money (Cloyne, 2012). This tax change would cost 350 million in a full year (HC Deb 27 October 1970 Vol 805 c37-75). Thus, we classify these tax changes as corporate income tax cut by 470 million on October 1970, and personal income tax cut by 350 million on April 1971.

The other example is the tax changes proposed in the 1984 Budget. There were considerable reforms to corporation income tax including remissions as well as withdrawal of certain relief. The purpose was to phase out some unnecessary relief in order to bring about, over time, a markedly lower rate of tax on company profits. Relief such as stock relief and capital allowances on plant and machinery were altered with the main rate of corporation tax and small company's rate being lowered. All these measures were expected to cost at around 450 million in net (HC Deb 13 March 1984 Vol 56 c295-301). The full year cost figure was assigned to 2nd quarter 1984. The National Insurance Surcharge (NIS) was also abolished from 1st October 1984 in continuation of help to British industry and was expected to cost 865 million (Cloyne, 2012) (Financial Statement and Budget Report (FSBR) March 1984). The 1984 budget changes were also made to lighten the burden of income taxes. There were sizeable remissions, funded by increase in Valued-added Tax (VAT) with a purpose of shifting burden from direct to indirect taxation. The main, additional and age allowances, the basic rate limit and the further higher rate limit were raised. All these changes were assigned an implementation date of 6th April 1984 (Cloyne, 2012). Their cost was considerable some 1470 million for a full year (FSBR March 1984). The Investment Income Surcharge was also abolished from 6th April 1984 as it was considered unfair for a small business man (Cloyne, 2012). The cost of this change was 340 million (FSBR March 1984). This package of income tax reductions was closely linked to the increases in indirect consumption taxes. Measures imposed included the removal of zero rating of various goods with respect to VAT from 1st May 1984. Additionally, fuel, alcohol, tobacco and vehicle excise duties rose from 13th March, 15th March and 14th March 1984 respectively (Cloyne, 2012). The total revenue raised form withdrawal of zero rates and increase in various excise duties was 865 million against an indexed base (FSBR March 1984). Therefore, we classify the tax changes in the 1984 Budget as corporate income tax cut by 450 million on April 1984 and 865 million on October 1984, personal income tax cut by 1810 million on April 1984, and consumption tax increase by 865 million on May 1984.

2.1.1 Comparison with Mertens and Ravn (2013) Series

Our classification of tax changes for the UK is based on the motivation behind each tax change. Changes in corporate income taxes include those measures that were designed to affect the industry and businesses. Changes in personal income taxes include those measure that were designed to affect individual income. This motivation driven classification of tax

changes is very similar and comparable to the classification of Mertens and Ravn (2013) of corporate and personal income taxes in the US. This will become more apparent as we briefly discuss the tax instruments implemented and the trend they followed over the years in the US and the UK.

For the corporate income taxes, there were a few types of changes introduced in the UK in 1950s and early 1960s aimed at boosting investment and improving competitiveness of the industry, through increasing initial allowances for investment and removing distortions in the system. For instance, single rate on distributed and undistributed profit was introduced in 1958. In 1965, capital gains tax was introduced with a few simplifications made in the later years. In 1970s, there were reforms to the corporation taxes mainly aimed at benefiting the small investors and simplifying the tax system. Some of the examples include introduction of new system of capital allowances, introduction of a special rate for small companies and increase in capital transfer tax relief as an incentive to expand, reforms to remove discrimination between retained and distributed profits as well as to close loopholes in the corporate tax system. One of the major tax reform in 1980s was the reduction in NIS over the years with the purpose of lowering the long term tax burden on the industry. [5] In 1990s and 2000s there were a series of cuts in the main corporate tax rate and small companies rate along with numerous tax changes meant to enhance growth and competitiveness of the industry. Some of the examples include introduction of new schemes such as Venture Capital Trusts, R&D tax credit and annual investment allowance.[6]

Although not such a wide variety of corporate tax instruments has been implemented in the US, their nature was very similar to the ones in the UK. Apart from the cuts in the main rate of corporate tax, there were three other types of instruments being implemented/modified that had an impact on the corporate tax liability. These include changes in depreciation allowances and guidelines, steps to reduce double taxation of businesses, more liberal treatment of research and development expenditure and changes to investment tax credit (Mertens and Ravn, 2013). These changes were meant to stimulate investment, productivity and increase the competitiveness of exports (Romer and Romer, 2010).

Thus, the comparison of corporate tax changes between the two countries shows that the types of instruments used to implement these changes have varied over the years. In the UK, changes in corporate income taxes have taken many forms including changes in tax rates, incentives for small businesses, introduction of new schemes to boost investment among others. In the US, on the other hand, changes in corporate income taxes have mainly

[5] National Income Surcharge (NIS) was a payroll tax levied on employers in 1976. The rate of NIS was reduced in 1982 and it was abolished in 1985 (Flora, 1986).

[6] A Venture Capital Trust (VCT) is a pooled fund that invests money in young enterprises in exchange for equity.
The annual investment allowance in the UK is a scheme using which businesses can write-off expenditure made on capital against taxable profits

been implemented through changes in tax rates or changes in depreciation guidelines. It's clear, however, that the main motivation for various types of corporate income tax changes has remained twofold: to lower tax liability for higher growth, and to boost investment. Overall, it seems reasonable to believe that the types and motivations behind corporate tax changes are broadly the same across the two countries.

For personal income taxes, in the UK, the changes were mainly driven by the motivation to provide relief to workers. The changes were implemented in different ways. These include changes related to personal tax allowances, child allowances, age related allowances and age exemption limits, dependent relative allowances and basic rate limits and thresholds. There were changes to the investment income surcharge in 1979 and 1983 to make the income tax system fairer and simpler, with it being abolished in 1984 to provide relief to small business men. There were a series of tax cuts in basic rate of income tax and marginal tax rates, starting in late 1980s accompanied with changes made to National Insurance Contribution of employees. There were similar changes in the US. They mainly consisted of cuts in personal tax rates and marginal tax rates along with a few other changes like increased income allowances for medical expenses, child care allowance, changes in tax treatment of medical insurance and sick benefits received by employees (Mertens and Ravn, 2013). Thus, apart from a few differences, the instruments used to implement personal income tax changes were largely the same across the two countries.

2.2 Other Tax Changes and Variables

Following Mertens and Ravn (2012), we use the announcement and implementation dates of tax changes documented in Cloyne (2013) to define anticipated and unanticipated tax changes for the UK. Anticipated tax changes are those where the lag between the announcement and implementation is more than one quarter, while unanticipated tax changes are those where the lag is less than one quarter. Figure 1 shows the distribution of the implementation lags of tax changes in the UK. The figure shows that most tax changes in the UK have an implementation lag of 2 quarters or less. However, there is one difference between the series for the US and the UK. The tax series for the US include retroactive components of tax changes, whereas those for the UK are without retroactive components. For robustness check, we also construct anticipated and unanticipated tax changes for the US excluding the retroactive components. We find that the results are robust to this change.

For positive and negative tax changes, we simply divide the two tax series according to their signs. Positive tax changes refer to tax increases and negative tax changes refer to tax cuts.

The data for other variables used in this paper comes from the national income accounts of

the two countries.[7] The analysis for the US covers the time period 1947:Q1 - 2007:Q4. Since quarterly data for GDP and other macroeconomic components in the UK is only available from 1955 onwards, we construct the measures of corporate and personal taxes for the time period: 1955:Q1 - 2007:Q4. To normalize the tax series, Mertens and Ravn (2013) divide the changes in corporate and personal income taxes by the pre tax personal incomes and corporate profits of the previous year. We could not find quarterly data of these series for the UK. Hence, we multiple the GDP of each quarter by 0.7 and 0.3 to get measures of corporate and personal income, respectively. These weights are standard and the results are qualitatively robust to changes in these weights. For comparability, the same method has been applied for the US data.

Figure 2 plots these disaggregated tax series for the UK. We can see that in the UK, the majority of corporate and personal income tax changes are tax cuts, of which most are within a change of 1 percent of GDP.

3 Empirical Methodology

With narrative accounts of exogenous tax series, there are largely three types of estimation methods.[8] As our focus is on how the effects of the UK tax changes compare with the US, we adopt the estimation methods used by Cloyne (2013). That is, we run a three variable VAR with the tax series exogenously entering the model.

The baseline model employed in this paper is the following VAR:

$$X_t = A + Bt + C(L)X_{t-1} + D(L)\Delta\tau_t + e_t. \tag{1}$$

X_t is a vector of endogenous variables consisting of three variables – output, consumption, and investment, in log levels. $\Delta\tau_t$ is the narrative series of exogenous tax changes. $C(L)$ and $D(L)$ are lag polynomials with P and $Q+1$ lags, respectively. Following Mertens and Ravn (2012), we choose $P = 1$ and $Q = 12$. The results are robust to different values of P. Depending on the type of tax changes we are interested in, the estimation model above requires further modification, which we specify in more details in the following sections.

Throughout the paper, for easy comparison the results for the US and the UK are presented side by side with the same scale. For the impulse responses, we provide both 68% and 95% confidence intervals. We begin by documenting the effects of total tax changes on output, consumption, and investment. The results are presented in Figure 3 for one

[7] BEA for the US and ONS for the UK.

[8] The three types of estimation methods are: 1) Romer and Romer (2010) run the estimation equation-by-equation with tax series entering the model as exogenous variables; 2) Mertens and Ravn (2012) and Cloyne (2013) use a VAR framework incorporating the tax series as exogenous variables; 3) Mertens and Ravn (2013) use the tax series as a proxy in a structural VAR framework.

percentage point tax cut, and they are in line with the results in Romer and Romer (2010) and Cloyne (2013). Overall the effects of total tax changes are fairly similar across the two countries. After a tax cut, output, consumption and investment gradually increase and reach the peak after about eight to ten quarters in both countries. It suggests that the reduction in taxes can improve the economy by boosting spending and investment. These effects take about two years to materialize. There are, however, some differences across the two countries. Consumption responds on impact in the UK, whereas the impact response in the US is insignificant. The most significant difference between the two countries is that the response of investment in the US is much more elastic than the UK. After a tax shock, for one percentage point increase in output, investment increases by 4 percentage points in the US. In contrast, in the UK for one percentage point increase in output, investment increases by roughly 1.8 percentage points.[9]

4 Results

In this section, we compare and contrast the responses of output, consumption and investment to the following tax changes in the US and the UK – corporate and personal income tax changes, anticipated and unanticipated tax changes, and positive and negative tax changes.

4.1 Corporate and Personal Income Tax Changes

In this subsection, we look at the dynamic effects of changes in corporate and personal income taxes. The empirical model we estimate is:

$$X_t = A + Bt + C(L)X_{t-1} + D(L)\Delta\tau_t^K + F(L)\Delta\tau_t^L + e_t \tag{2}$$

where $\Delta\tau_t^K$ and $\Delta\tau_t^L$ represent changes in corporate and personal income taxes, respectively. We use the VAR model estimation taking the narrative accounts of tax series as exogenous. It is different from the one employed in Mertens and Ravn (2013), which uses narratively identified tax changes as proxies for structural tax shocks in the US.

Figure 4 shows the responses to a one percentage point reduction in corporate income taxes in the US and the UK. The difference between Panel B-1 and B-2 for the UK is that the employment taxes are included in the alternative tax series, but not in the baseline. There are three interesting observations. First, the effects of corporate income taxes in the UK are relatively smaller than the US. The peak output response in the UK is 2 percentage

[9]It is calculated by the peak response of investment divided by the peak response of output. In the US, the peak response of output is around 2.5 percent, and the peak response of investment is around 10 percent. In the UK, the peak response of output is around 2.3 percent, and the peak response of investment is around 4.1 percent.

points, while it is around 2.8 percentage points in the US. The same is true for consumption and investment. Secondly, the responses of the UK economy to a change in corporate income tax are much more sluggish than those in the US. In the US, output increases significantly two quarters after the tax shock. In contrast, in the UK output falls slightly, though insignificantly, in the first year and then starts increasing two years after the shock. The similar pattens can be seen for both consumption and investment. Thirdly, comparing the peak responses of investment with output, investment is much more elastic in the US than the UK. The ratio of peak investment response to peak output response is 4.6 in the US and 1.9 in the UK, respectively.

The effects of personal income tax changes in the US, shown in Panel A of Figure 5, are similar to those of total tax changes, and in line with what Mertens and Ravn (2013) find. However, the estimation of effects of personal income tax changes in the UK is complicated by the fact that some of the personal income tax changes might be endogenous. Cloyne (2013) discusses about the issue of packages of measures or actions designed to offset other actions. In particular, between 1979 and 1997, there were a number of increases in consumption taxes that were designed to fund the income tax cuts that were taking place at the same time in the UK. For example, in 1979, there were significant cuts in personal income taxes. At the same time, indirect taxes were increased and the size of the two tax changes were almost the same. Similarly, in 1985, income taxes were cut but at the same time, duties on various goods were increased and other changes were made to the VAT that were designed to fund the cuts in income taxes. We treat all personal income tax changes accompanied by offsetting consumption tax changes as endogenous. For instance, in the 1979 budget where VAT was increased to finance the personal income tax cut, it can be argued that personal income tax was in fact "endogenous" in that it was *responding* to the VAT increase. So we construct the baseline series of personal income tax changes by excluding those personal income taxes which are offset by those consumption tax changes in the same budget. The rich nature of the narrative descriptions of tax changes in Cloyne (2012) makes this easier for us. Between 1979 and 1993, there are six instances of increases in consumption taxes that were made at the same time when personal income taxes were to decrease.

Panel B-1 of Figure 5 presents the impulse responses to the personal income tax cuts in the UK. Output increases immediately following a cut in personal income taxes, and reaches the peak - 1.1 percentage points after one quarter, though the responses remain insignificant at most of the horizons. Consumption shows an immediate and large increase, which persists for three years. The response of investment to a cut in personal income taxes is positive but insignificant at all horizons. Compared with the effects of personal income taxes in the US, the peak responses in the UK are similar in size, but less sluggish. In the UK, output immediately jumps up after a tax shock, while in the US, output only starts increasing after six quarters. Moreover, comparing the peak responses of investment with output, investment is much more elastic in the US than the UK. The ratio of peak investment response to peak

output response is 4 in the US and 2.1 in the UK, respectively. The results remain largely unchanged when we include the employment taxes, shown in Panel B-2.

For comparison, Panel B-3 of Figure 5 presents the estimated responses using all personal income tax series, including both the baseline tax series and those personal income taxes which are offset by consumption tax. It seems to suggest that a reduction in personal income tax leads output to fall, rather than increase. Similarly, consumption seems to decrease in the long-run in response to a decrease in personal income taxes, though insignificantly, and investment falls significantly following a personal income tax cut. These results contradict the standard economic theory and shows that the endogeneity issue caused by offsetting consumption taxes needs to be addressed. Moreover, we run a similar regression with all personal income tax series, but controlling for all other exogenous tax changes.[10] We normalize all other taxes by nominal GDP and include current and 12 lags of the this measure of other taxes. The list of endogenous variables include output, consumption, and investment. Panel B-4 of Figure 5 shows that for the UK, controlling for other taxes alter the results in Panel B-3. The output increases though insignificantly. Consumption, on the other hand, shows a significant increase following a decrease in personal income taxes which persists for around 10 quarters. The responses of investment remain insignificant at all horizons. We find that these results are very similar to the baseline case where we exclude those personal income tax changes offset by consumption taxes. Thus, we conclude that for the UK, those personal income tax changes which are offset by consumption taxes at the same time are endogenous and potentially contaminate the estimated effects of personal income tax changes.

4.1.1 Robustness Check

Here, we further explore the possible channels to explain the different effects of changes in corporate and personal income taxes that we observe across the two countries. We examine the responses of government spending and short-term interest rates to changes in corporate and personal income taxes. The data for these variables comes from Romer and Romer (2010) and Cloyne (2013) (who in turn use the national income accounts data and data from the central banks of the two countries). We run a three-variable VAR with log of output, log of real government spending, and interest rates. As usual, we include current value and 12 lags of corporate and personal income tax changes. We use one lag of the endogenous variables.

Panel B of Figure 7 shows that in the UK, government spending moves in the same direction as the change in personal income taxes i.e. if personal income taxes are decreased then this is followed by large and significant decreases in government spending. The response of government spending to decrease in personal income taxes is opposite in the US. In the

[10] All other exogenous tax changes is the Cloyne (2013) tax series minus all the personal income tax changes.

US, government spending increases when personal income taxes are decreased. Thus, it seems that while changes in government spending reinforce the effects of change in personal income taxes in the US, the opposite takes place in the UK: personal income tax decreases are accompanied by decreases in government spending which mute the ex-ante expected effects of decreases in personal income taxes. The results also show that government spending seems to react differently to changes in corporate income taxes in the two countries. While the response of government spending to decreases in corporate income taxes is positive but insignificant in the UK, shown in Panel B of Figure 6 , it is negative and significant in the US, shown in Panel A of Figure 6. We find that changes in corporate income taxes have larger and stronger long-run effects in the UK. It is possible that the response of government spending counters the expansionary effects of cuts in corporate income taxes in the US while this channel is absent in the UK.

For the responses of interest rate, in the US, they do not seem to react significantly to cuts in either personal income taxes or corporate income taxes. In the UK, however, interest rate increases significantly when personal income taxes are cut. Interest rate can increase by up to 2 percentage points when personal income taxes are cut. It acts to reverse the potential expansionary effects of cuts in personal income taxes. Cloyne (2013) show that an exogenous increase in interest rate of one percentage point can lead to a decline in output by up to 0.6 percent. Cut in corporate income taxes in the UK leads to mostly insignificant effects on interest rates. Only in the long run do we find marginally significant effects.

We also study the response of other taxes to changes in corporate and personal income taxes for both countries. For this, we include the series of other tax changes as an endogenous variable for both countries. The results show that other taxes do not respond significantly to changes in corporate and personal taxes in either of the two countries. The response are small with large standard errors and are often not of the same sign consistently. Thus, it is unlikely that the different results of changes in corporate and personal income taxes are driven by responses of other tax changes.

Thus, our analysis suggests that the different responses of government spending and interest rates may potentially explain the different effects of corporate and personal income tax changes we observe across the two countries.

4.2 Anticipated and Unanticipated Tax Changes

Following Mertens and Ravn (2012), who examine the anticipated and unanticipated tax changes in the US, we estimate the following empirical model:

$$X_t = A + Bt + C(L)X_{t-1} + D(L)\Delta\tau_t^u + F(L)\Delta\tau_{t,0}^a + \sum_{i=1}^{K} G_i \Delta\tau_{t,i}^a + e_t. \tag{3}$$

$\Delta\tau_t^a$ and $\Delta\tau_t^u$ denote the anticipated and unanticipated tax series, and $D(L)$ and $F(L)$ are $Q+1$-order polynomials. $\Delta\tau_{t,i}^a$ is the anticipated tax changes with i anticipation period, and K is the maximum anticipation horizon. The anticipation effects are captured by the term G_1 - G_K. Mertens and Ravn (2012) choose $K = 6$ for the US. However, we find that the anticipation horizon - the time difference between announcement and implementation of a tax change - in most cases in the UK is less than 6. In fact, most tax changes in the UK have an anticipation horizon of 3 or 4 quarters. Hence, we choose $K = 4$ for the UK. For the sake of comparison, we also choose $K = 4$ for the US. The results are shown in Figure 8 and 9, and the impulse responses are those responding to a one percentage point tax reduction.

Earlier studies like Poterba (1988) and Heim (2007) use household level data to study the effects of announced but not yet implemented tax changes. These studies could not find conclusive evidence in favor of the anticipation effects of announced tax changes. Parker (1999) and Souleles (2002) also find that consumption plans only change when tax changes are implemented. Our results, however, confirm the findings in Mertens and Ravn (2012), that anticipated and unanticipated tax changes have very different effects on the economy. This is particularly evident for the UK. With anticipated tax changes the economy responds immediately with the effects gradually dying down, whereas with unanticipated tax changes, the responses are of hump-shaped.

Figure 9 presents the impacts of unanticipated tax changes in the US and the UK. Overall for both countries, the responses resemble the effects of total tax changes, which are largely the same across the two countries. In contrast , the impact of anticipated tax changes differ dramatically across the two countries in terms of direction, magnitude and timing, shown in Figure 8. In the US, output falls slightly and insignificantly when a tax cut is announced. It only starts to increase three quarters after the implementation and reaches the peak after ten quarters of the implementation. The responses, however, are then persistent in the long-run. In the the UK, on the other hand, output increases immediately after the announcement of a tax cut. The responses then start to taper off after a year and the long-run responses are small and insignificant. Similar results are shown for consumption and investment. The initial responses of consumption and investment in the US are insignificant, when a tax cut is announced. Overtime, the effects reach the peak two and a half years after the implementation, and the responses are large and significant in the long run. Whereas, in the UK when a tax cut is announced, consumption and investment jump up by 3 and 10 percentage points, respectively. The effects then gradually die down. If we compare the investment responses between the two countries, relative to the output responses, investment again is much more elastic in the US than the UK. For one percentage point increase in output, investment rises by five percentage points in the US, while in the UK for one percentage point increase in output, investment rises by roughly two percentage points.[11]

[11]The peak responses of output and investment in the US are 2 and 10 percentage points, respectively. And, they are 6.8 and 13 percentage points in the UK, respectively.

Our results do not have the very strong negative anticipation effects for the US, as shown in Mertens and Ravn (2012). It is likely due to the number of anticipation horizons used in the estimation. When we change it from $K = 4$ to $K = 6$ for the US, we do see both output and consumption drop significantly when a tax cut is announced. Mertens and Ravn (2012) argue that the negative anticipation effects found in the case of the US are evidence that firms delay their capital goods purchases when a tax cut is announced. At the same time, the results, in particular the negative response of consumption to announcement of tax cuts, are not consistent with the predictions of the standard life cycle model where consumers increase current consumption in response to news about an increase in future income. This suggests that vast majority of consumers are credit constrained who cannot use borrowing to increase their current consumption against a higher future income. In the UK, however, positive anticipation effects associated with announcement of tax cuts are consistent with a standard life cycle model. Therefore, it is interesting to examine why tax cuts have different types of anticipations effects in the two countries.

4.3 Positive and Negative Tax Changes

To investigate the effects of positive and negative tax changes, we estimate the following VAR:

$$X_t = A + Bt + C(L)X_{t-1} + D(L)\Delta\tau_t^+ + F(L)\Delta\tau_t^- + e_t, \tag{4}$$

where $\Delta\tau_t^+$ and $\Delta\tau_t^-$ denote positive and negative tax changes, and $D(L)$ and $F(L)$ are lag polynomials with order $Q + 1$. However, as pointed out by Kilian and Vigfusson (2011), the problem with this linear model is that the directly estimated impulse responses are biased. Therefore, a simplified version of the Kilian and Vigfusson (2011) methodology is used to compute impulse responses in this subsection. We start with estimating the VAR given in equation (4). Then, we draw various initial conditions and sequences of tax-changes, and simulate two time series of the variables – one based on the draws and the other where we replace the first value of either of the two positive or negative sequence of tax changes by a constant. We compute the difference between these two time series and average over the number of draws. The impulse-responses are calculated as the average of aggregate effect over different initial conditions and subsequent tax changes.[12] The results are shown in Figure 10 and 11.

A simple textbook economic theory tells us that a tax cut can stimulate economy by boosting spending and investment, and a tax increase can do just the opposite. Figure 10 presents the estimated effects of a one percentage point tax increase in the US (Panel A) and UK (Panel B-1). For the US, the responses of output and consumption are small and insignificant, though the investment drops by 15 percentage points.[13] In contrast, for the

[12]For more details in computing impulse responses, please refer to Hussain and Malik (2016).

[13]As shown in Hussain and Malik (2016), the lack of effect from a tax increase in the US comes from a

UK, the responses of all variables are large, significant and long-lasting. For instance, output drops immediately after a tax increase, and then gradually decreases and reaches the trough after two and half years by 6.6 percentage points. It is larger than the effects of total tax changes in the UK. Therefore, the effects of positive tax changes are very different across the two countries. It seems to suggest a tax increases may not have any impact on the economy in the US, while it does slow down the economy in the UK. Figure 11 presents the estimated effects of a one percentage point tax cut in the US (Panel A) and UK (Panel B-1). Following a tax cut in the US, the output starts increasing after two quarters and reaches the peak after two and a half years at 2.8 percentage points. The responses of consumption closely follow the movement of output, and the changes in output and consumption are almost one-for-one. In contrast, the effects of a tax cut in the UK are small and insignificant. Similar results can be seen for consumption. It implies that the effects of a tax increase and tax cut are very different across two countries.

Both Cloyne (2013) and Nguyen et al. (2017) consider the effects of outliers in 1979 and 1988.[14] We are wondering whether the results for the UK are sensitive to those outliers in the data. There are three outliers. The first two outliers are from 1979 budget. There were two main changes in this budget. First, there were a series of income tax cuts – income tax rates above 60 percent were abolished and some changes to the income tax brackets were made. At the same time, increases in different allowances like personal and age allowances were made. There were changes to the investment income surcharge thresholds and basic rate of income tax was cut by 3 percent (Cloyne, 2012). The total cost of these income tax reductions was 3496 million. Secondly, the budget also included increases in VAT that were designed to offset the costs of income tax remissions. The central theme of the budget was to shift taxes from income to spending. The major change was that VAT rates were unified at 15 percent from June 18, 1979 raising 4175 million in a full year. Along with increases in fuel duties which would yield around 525 million in full year, consumption tax increased total by 4700 million. The other outlier is the personal income tax cuts of 1988 which were also accompanied by offsetting increases in consumption taxes although the increases were not equal to the decreases in personal income taxes.

We drop these three outliers from our series and re-estimate the effect of a tax increase and tax cut in the UK, shown in Panel B-2 in both Figure 10 and 11. The estimated effects of

ratchet effect in consumption whereby workers increase labor supply to maintain their consumption levels. Thus, although total output and consumption remains the same, leisure falls when taxes are increased.

[14]Cloyne (2013) considers the large positive and negative tax changes from direct to indirect taxes in 1979. The timing of the income tax cuts in 1979Q4, which were to be counteracted by the VAT rise in 1979Q3, lead to two large outliers in the tax series. Nguyen et al. (2017) considers tax changes in 1979 and 1988 as endogenous, as some tax changes were rumoured or trailed prior to their announcements, such as in electoral manifestos, and macro variables may have responded to those rumours before the changes were officially implemented. This is the case for the policy changes implemented right after two general elections, in 1979:III and in 1988:II.

a tax increase become small and insignificant, similar to the results for the US. For a tax cut, both output and consumption increase two and half years, though the effects on investment are insignificant. It is similar to the effects of total tax changes in the UK and also the effects of tax cuts in the US. Thus, when we compare the effects of tax increases and tax cuts between the two countries, it is sensitive to the outliers in the data.[15] By removing all three outliers, the effects are very similar across the two countries. In addition, investments in both countries respond to tax cuts much more than output and consumption. However, relative to the output responses, investment is much more elastic in the US than the UK. For one percentage point change in output, investment moves by 3.9 percentage points in the US, while in the UK for one percentage point change in output, investment moves by roughly 1.7 percentage points.[16]

5 Conclusion

In this paper, we compare and contrast the effects of various types of discretionary tax changes between the US and the UK. We construct series of corporate and personal income tax changes, and anticipated and unanticipated tax changes in the UK, using the data from Cloyne (2013) and other resources including house of common debates, government budget reports and etc. Our paper shows that various types of tax changes between the two countries can have different quantitative and qualitative impacts, in spite of the similarities for the total tax changes.

These results suggest that it is important to take into account such differences before designing a taxation policy for a specific country since generalizing the effects of tax changes across countries may lead to sub-optimal results. Our results also highlight the importance of studying country specific attributes of tax changes. For example, in the UK, those personal income tax changes which are offset by consumption taxes at the same time are endogenous and potentially contaminate the estimated effects of personal income tax changes.

Therefore, it is important to study whether the impacts of changes in certain taxes are because of an underlying structural feature of the economy or whether they are simply driven by attributes of the tax policy. It has two implications for policy makers. First, looking at the effects of overall tax changes can be misleading. Different sub-categories of tax changes can have vastly different effects so policy makers need to take into account the nature of a particular tax change. Secondly, generalizing the effects of tax changes across countries can yield sub-optimal results. An optimal taxation policy for one country may not be effective for the other country. Academically, the paper presents several interesting puzzles, which

[15] It is noted that the effects of total tax changes are not really sensitive to these outliers.

[16] The peak responses of output and investment in the US are 2.8 and 11 percentage points, respectively. And, they are 2.1 and 3.5 percentage points in the UK.

require further analysis into what are indeed the mechanisms responsible for the different responses to tax changes across the two countries.

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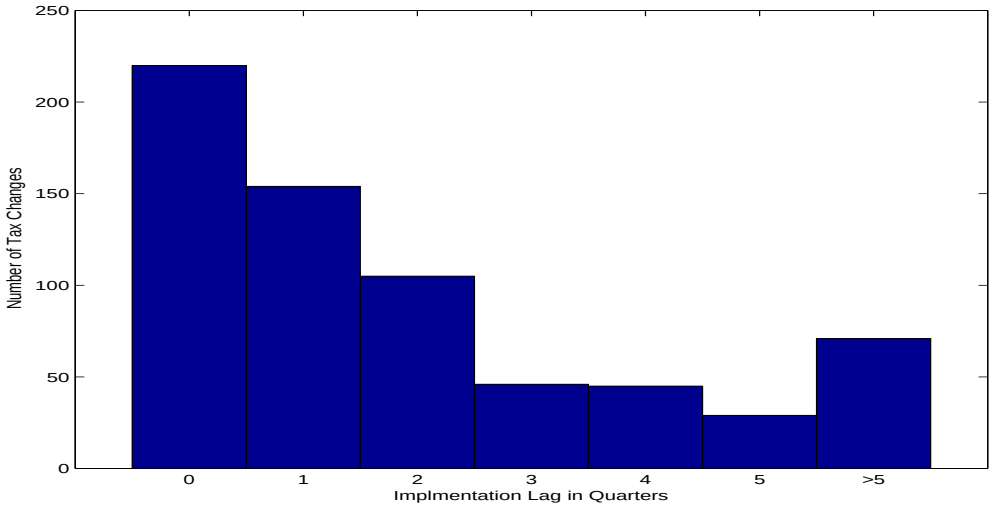
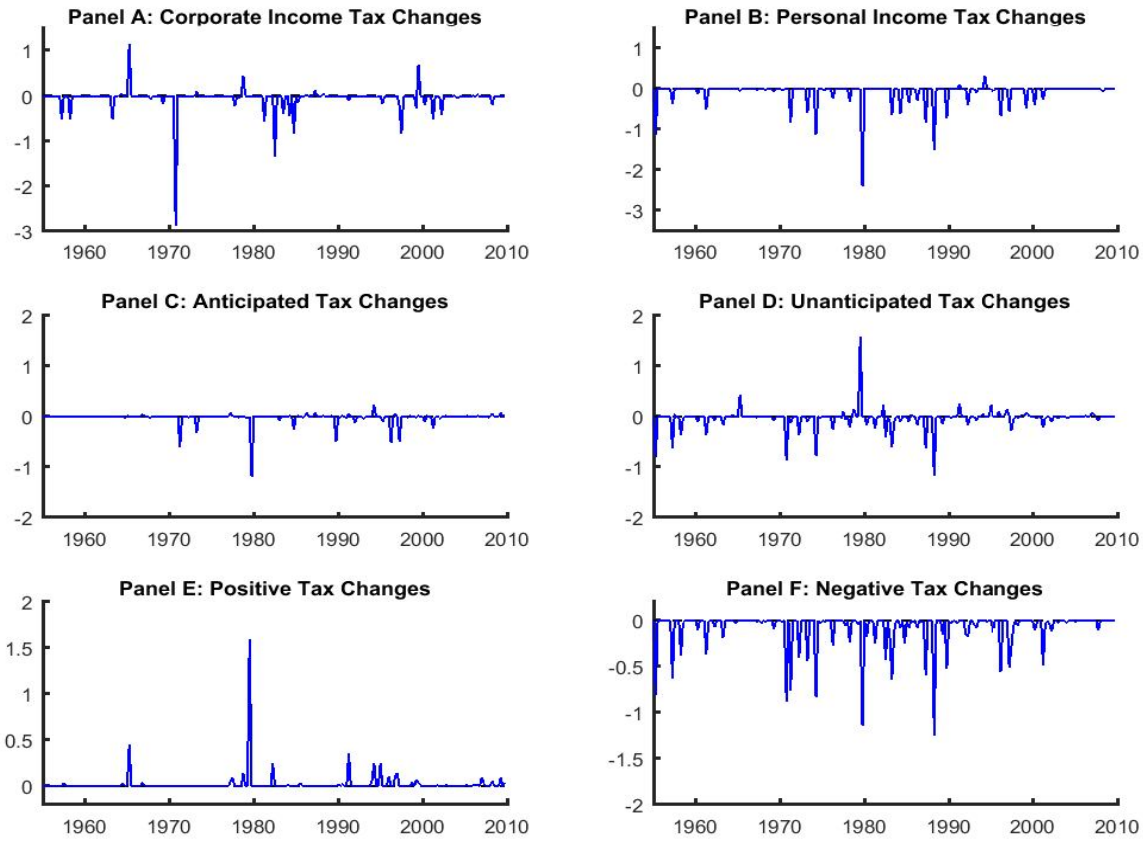
Figure 1: Distribution of Implementation Lags Across Tax Changes in the UK



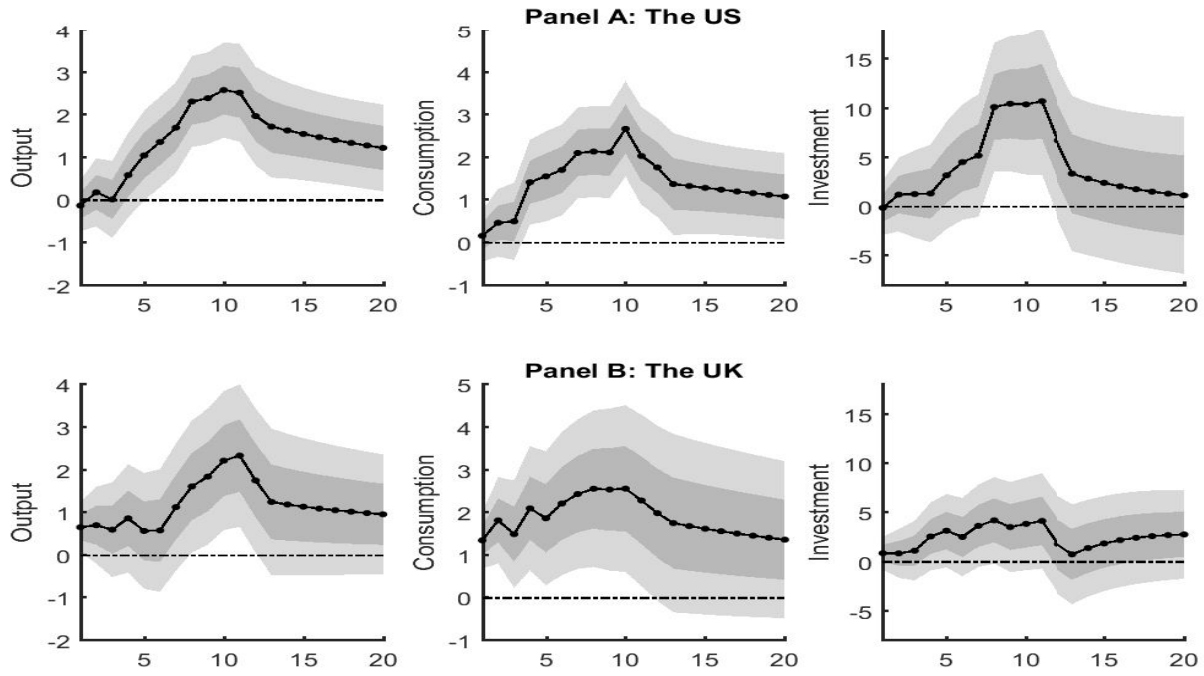
Notes: The figure plots the number of anticipated tax changes according to their implementation lags for the UK.

Figure 2: Discretionary Tax Changes in the UK at Disaggregated Levels



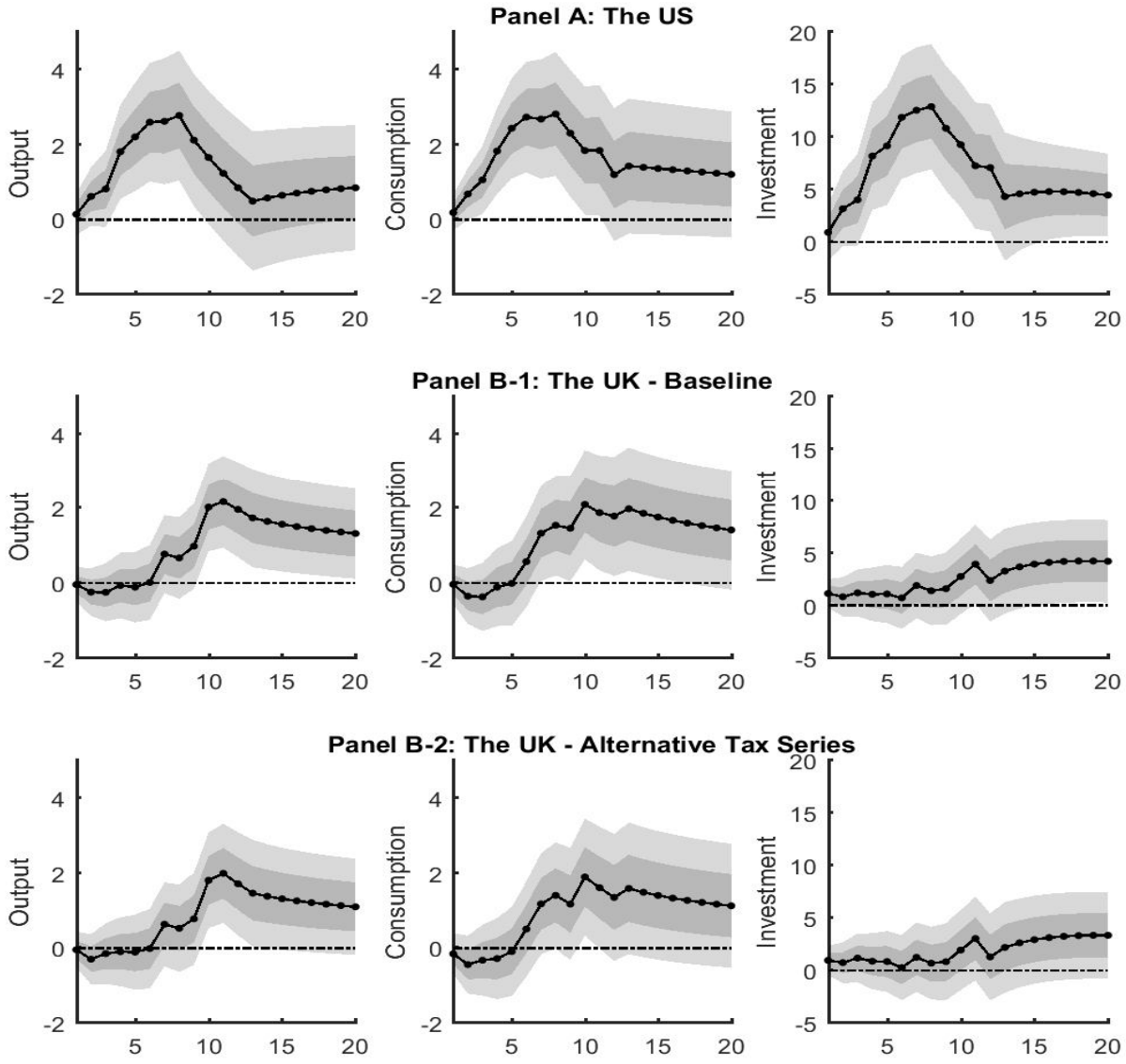
Notes: The figure presents exogenous tax change series in the UK at disaggregate levels –corporate (Panel A) and personal (Panel B) income tax changes, anticipated (Panel C) and unanticipated (Panel D) tax changes, and positive (Panel E) and negative (Panel F) tax changes.

Figure 3: Effects of Total Tax Changes



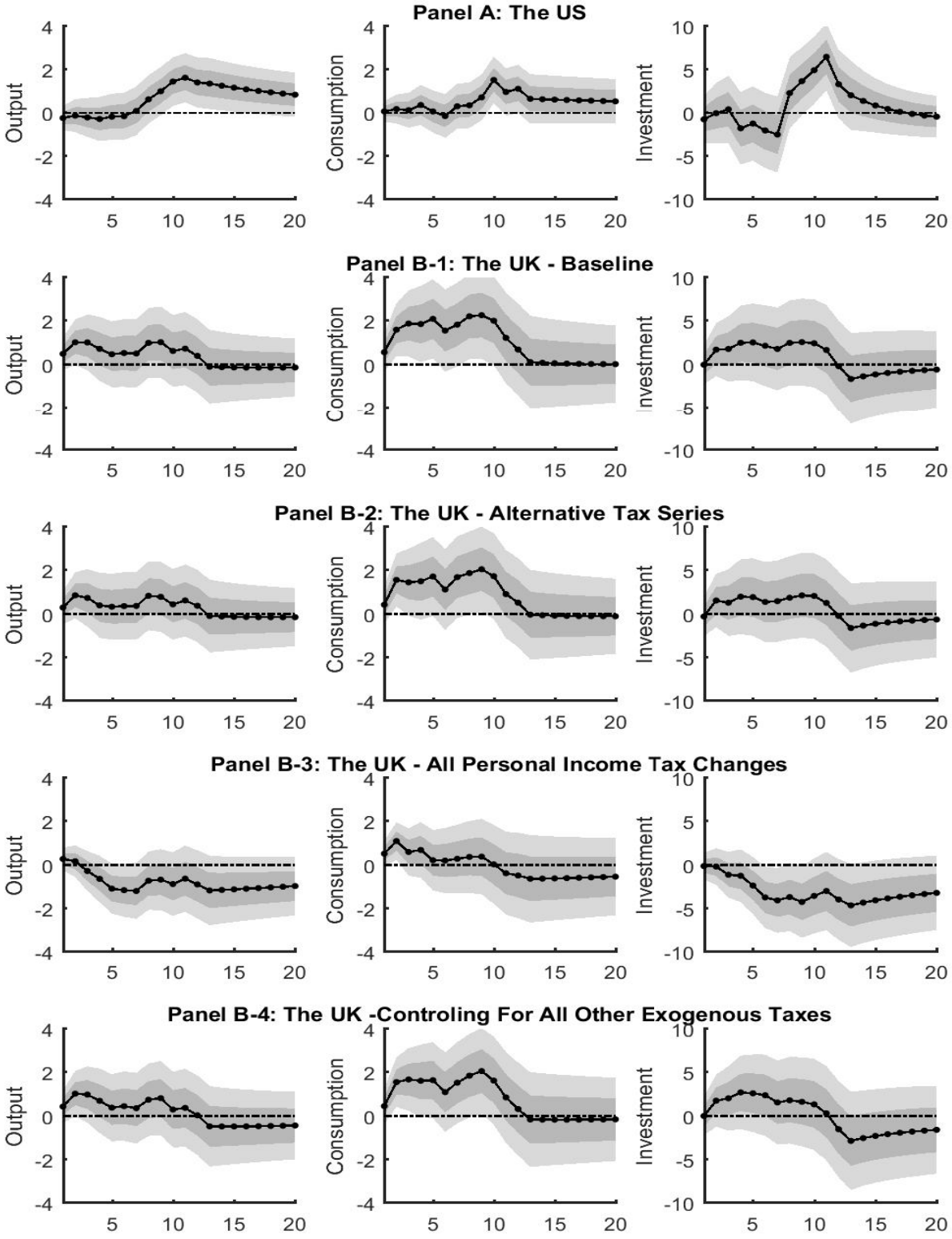
Notes: Panel A (B) shows the responses of output, consumption and investment to a 1 percentage point cut in total tax changes in the US (UK).

Figure 4: Effects of Corporate Income Tax Changes



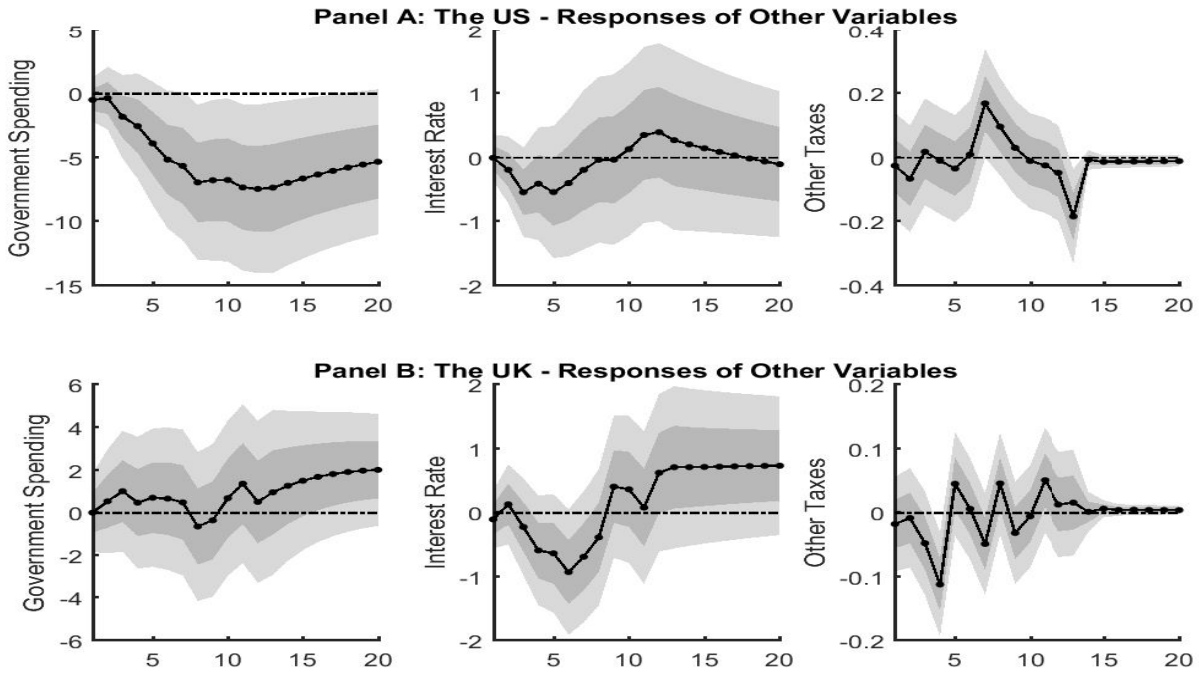
Notes: Panel A shows the responses of output, consumption and investment to a 1 percentage point reduction in corporate income taxes for the US. Panel B-1 provides the responses in the UK for the baseline scenario, and Panel B-2 provides the responses with the alternative tax series.

Figure 5: Effects of Personal Income Tax Changes



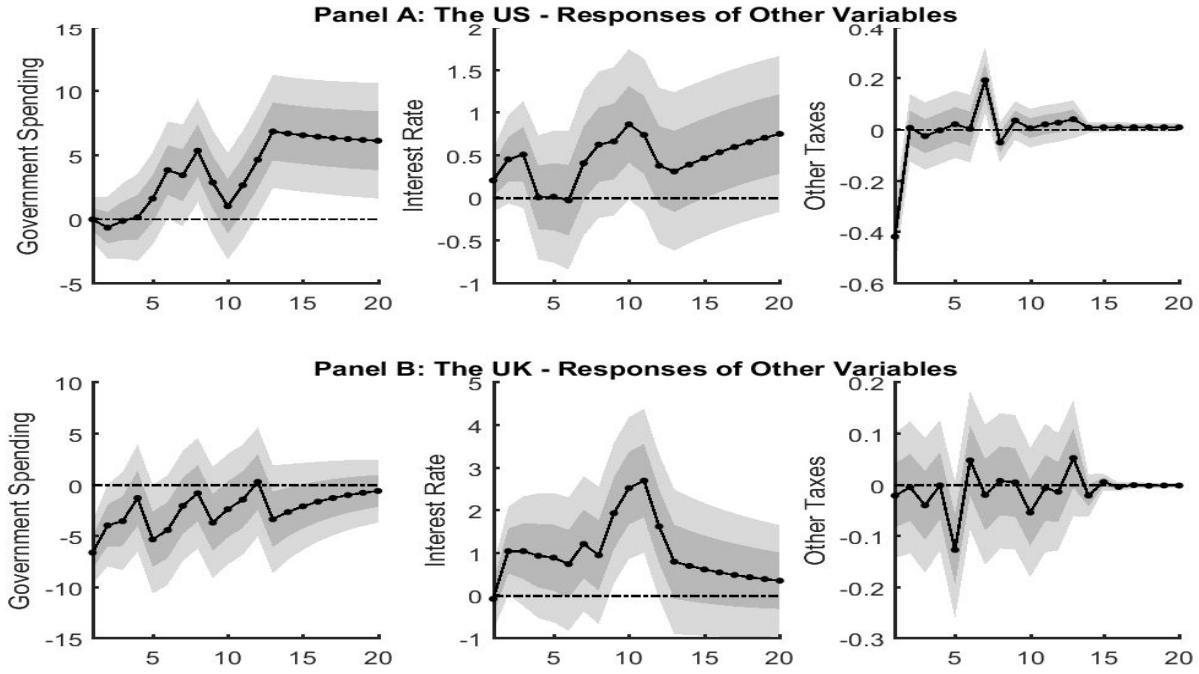
Notes: Panel A shows the responses of output, consumption and investment to a 1 percentage point reduction in personal income tax in the US. Panel B shows the responses in the UK: the baseline (B-1), the alternative tax series (B-2), all personal taxes including the baseline tax series and those personal taxes which are offset by the consumption taxes (B-3), and controlling for all other exogenous taxes (B-4).

Figure 6: Robustness Check on Effects of Corporate Income Tax Changes



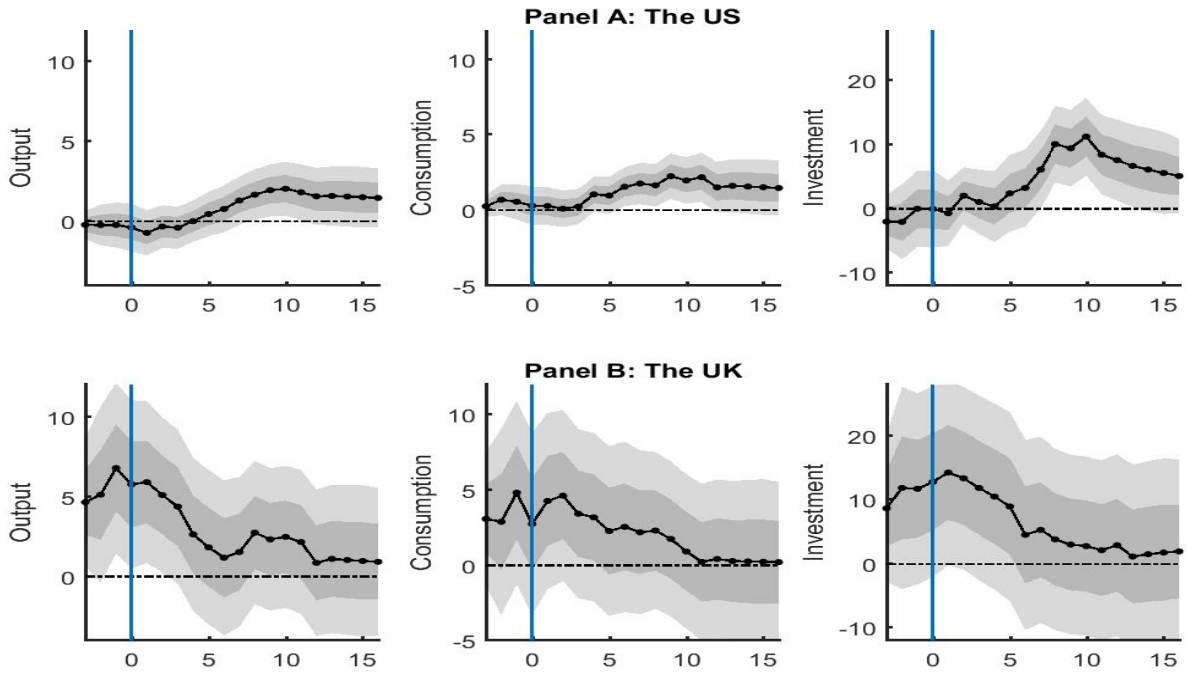
Notes: Panel A (B) provides responses of other variables: government spending, interest rate and other taxes for the US (UK).

Figure 7: Robustness Check on Effects of Personal Income Tax Changes



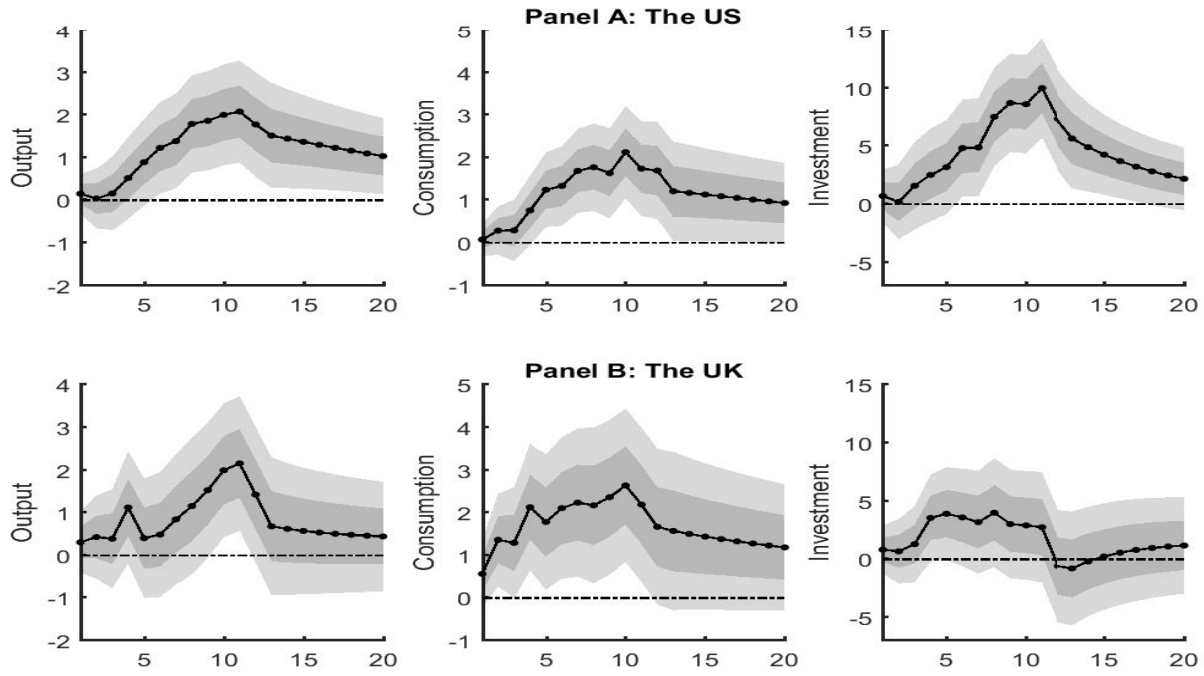
Notes: Panel A(B) provides responses of other variables: government spending, interest rate and other taxes for the US (UK).

Figure 8: Effects of Anticipated Tax Changes



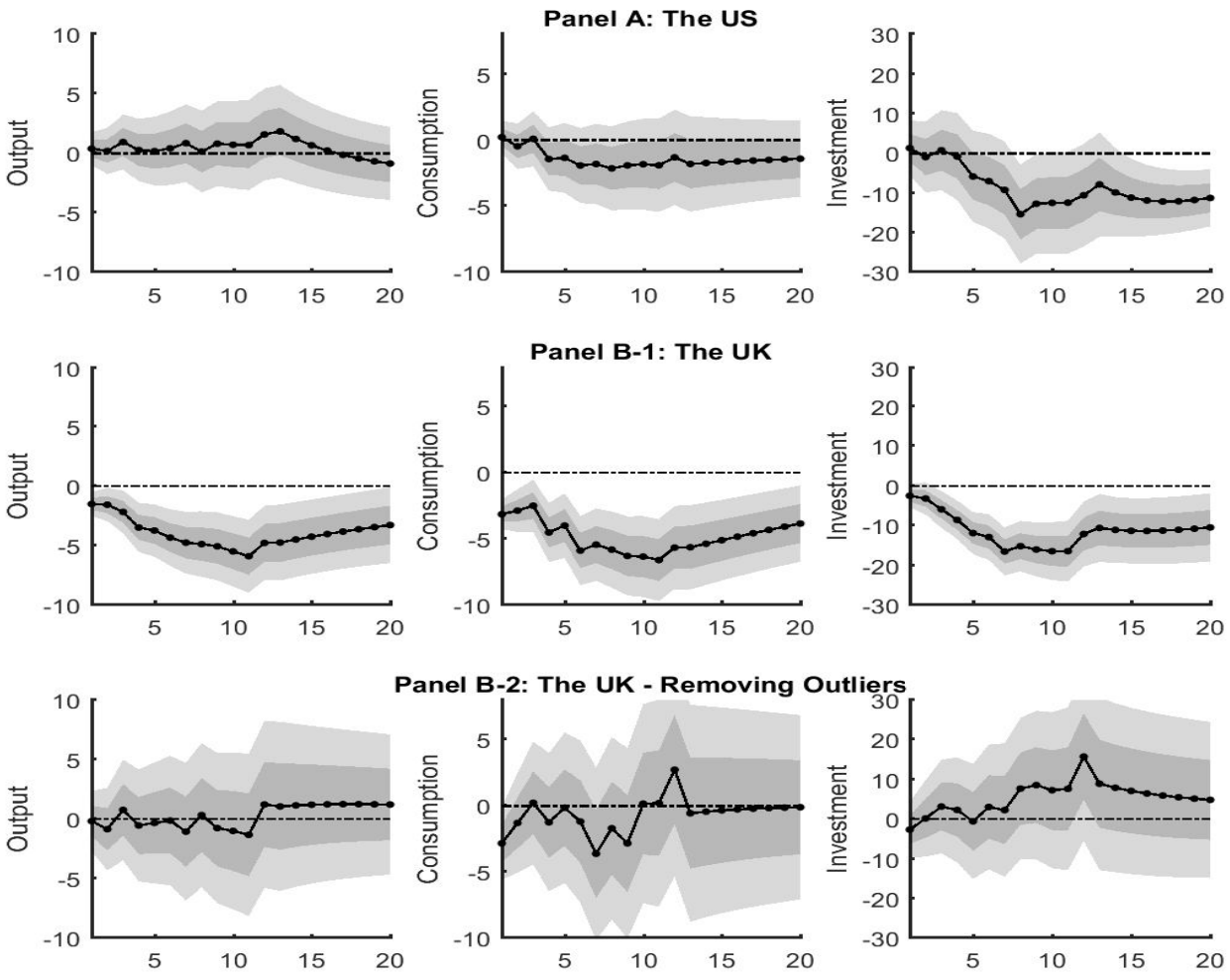
Notes: Panel A (B) shows the responses of output, consumption and investment to a 1 percentage point reduction in anticipated taxes for the US (UK).

Figure 9: Effects of Unanticipated Tax Changes



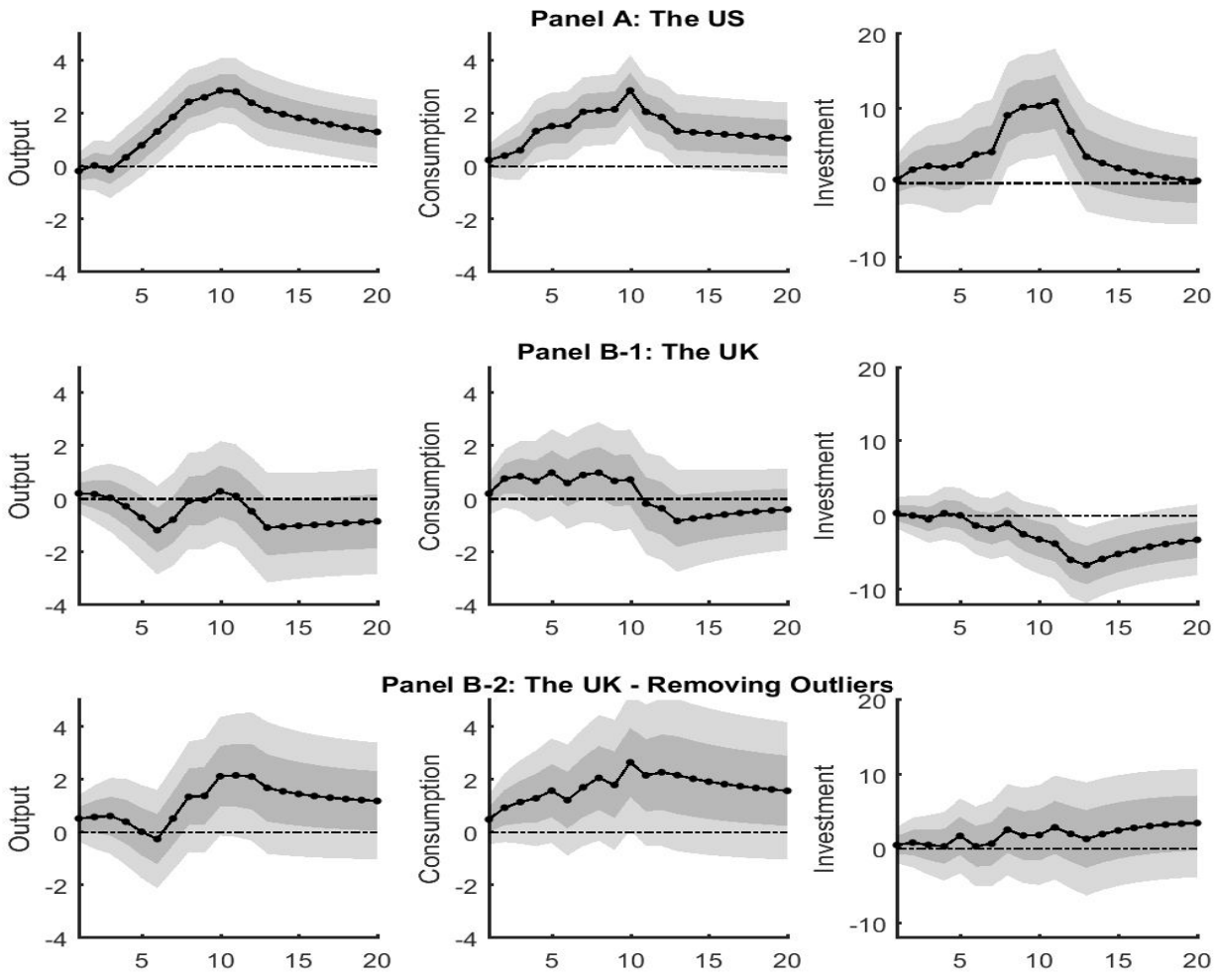
Notes: Panel A (B) shows the responses of output, consumption and investment to a 1 percentage point reduction in unanticipated taxes for the US (UK).

Figure 10: Effects of Positive Tax Changes (Tax Increases)



Notes: Panel A shows the responses of output, consumption and investment to a 1 percentage point tax increase in the US. Panel B-1 shows the responses in the UK, and Panel B-2 shows the responses by removing outliers.

Figure 11: Effects of Negative Tax Changes (Tax Cuts)



Notes: Panel A shows the responses of output, consumption and investment to a 1 percentage point tax cut in the US. Panel B-1 shows the responses in the UK, and Panel B-2 shows the responses by removing outliers.